# Responses of savanna lawn and bunch grasses to water limitation

van der Plas, Alfons; Zeinstra, Patricia; Veldhuis, Michiel; Fokkema, Rienk; Tielens, Elske; Howison, Ruth; Olff, Han

*Published in:*
Plant ecology

*DOI:*
10.1007/s11258-013-0240-8



*Publication date:*
2013

Supplementary material of: 'Responses of savanna lawn and bunch grasses to water limitation', Plant Ecology

AUTHORS: Fons van der Plas[1,*], Patricia Zeinstra[1], Michiel Veldhuis[1], Rienk Fokkema[1], Elske Tielens[1], Ruth Howison[1], Han Olff[1]

AUTHOR AFFILIATIONS:

[1]Community and Conservation Ecology Group, Center for Ecological and Evolutionary Studies, University of Groningen, P.O. Box 11103, 9700 CC, Groningen, The Netherlands

[*]Corresponding author. E-mail: fonsvanderplas@gmail.com. Telephone: +31 503632231. Fax: +31 503632273

| Trait | **lawn species** | | | | | | **bunch species** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Cynodon dactylon* | | *Dactyloctenium australis* | | *Digitaria longiflora* | | *Eragrostis curvula* | | *Setaria sphacelata* | | *Sporobolus pyramidalis* | |
| | control | drought | control | drought | control | drought | control | drought | control | drought | control | drought |
| evaporation week 4 (mL $day^{-1}$) | 11.22 ± 3.20 | 8.35 ± 4.13 | 11.03 ± 2.86 | 6.82 ± 0.91 | 4.14 ± 2.97 | 3.37 ± 0.65 | 6.48 ± 5.01 | 5.89 ± 3.07 | 9.67 ± 2.13 | 9.56 ± 5.41 | 5.20 ± 2.92 | 3.34 ± 2.07 |
| evaporation week 7 (mL $day^{-1}$) | 24.83 ± 4.22 | 0.10 ± 0.25 | 20.15 ± 6.46 | 0.06 ± 0.12 | 9.15 ± 5.64 | 0.79 ± 0.37 | 18.57 ± 10.21 | 0.73 ± 1.44 | 18.23 ± 3.83 | 0.01 ± 0.65 | 10.87 ± 5.08 | 1.95 ± 0.98 |
| evaporation week 9 (mL $day^{-1}$) | 30.45 ± 5.97 | 17.29 ± 5.05 | 25.95 ± 9.08 | 20.10 ± 0.59 | 9.79 ± 5.40 | 7.90 ± 2.38 | 24.34 ± 10.20 | 14.73 ± 2.82 | 21.40 ± 2.77 | 15.66 ± 5.74 | 14.05 ± 6.99 | 6.17 ± 2.80 |
| absolute growth (g) | 10.82 ± 2.00 | 4.42 ± 0.83 | 7.56 ± 0.86 | 3.91 ± 0.62 | 4.07 ± 1.04 | 2.57 ± 0.49 | 7.75 ± 2.17 | 4.42 ± 0.84 | 9.00 ± 1.79 | 5.23 ± 1.21 | 6.14 ± 1.14 | 3.06 ± 0.91 |
| relative growth rate (g $g^{-1}$ $day^{-1}$) | 0.048 ± 0.003 | 0.034 ± 0.003 | 0.045 ± 0.001 | 0.038 ± 0.003 | 0.038 ± 0.004 | 0.033 ± 0.004 | 0.036 ± 0.005 | 0.032 ± 0.005 | 0.038 ± 0.004 | 0.031 ± 0.003 | 0.030 ± 0.004 | 0.022 ± 0.005 |
| water use efficiency (g $mL^{-1}$) | 0.011 ± 0.002 | 0.012 ± 0.002 | 0.010 ± 0.001 | 0.011 ± 0.002 | 0.011 ± 0.002 | 0.013 ± 0.003 | 0.011 ± 0.002 | 0.013 ± 0.003 | 0.012 ± 0.002 | 0.014 ± 0.002 | 0.013 ± 0.002 | 0.016 ± 0.004 |
| RLAR drought (leaf $leaf^{-1}$ $day^{-1}$) | 0.066 ± 0.002 | 0.033 ± 0.002 | 0.062 ± 0.003 | 0.031 ± 0.003 | 0.066 ± 0.007 | 0.043 ± 0.006 | 0.040 ± 0.006 | 0.020 ± 0.003 | 0.042 ± 0.008 | 0.018 ± 0.002 | 0.035 ± 0.005 | 0.030 ± 0.005 |
| RLAR recovery (leaf $leaf^{-1}$ $day^{-1}$) | 0.031 ± 0.003 | 0.035 ± 0.002 | 0.030 ± 0.003 | 0.055 ± 0.004 | 0.043 ± 0.002 | 0.056 ± 0.006 | 0.018 ± 0.004 | 0.038 ± 0.004 | 0.014 ± 0.003 | 0.036 ± 0.004 | 0.037 ± 0.010 | 0.029 ± 0.003 |
| root weight fraction | 0.24 ± 0.04 | 0.18 ± 0.02 | 0.11 ± 0.02 | 0.14 ± 0.01 | 0.16 ± 0.02 | 0.19 ± 0.02 | 0.24 ± 0.02 | 0.26 ± 0.03 | 0.36 ± 0.02 | 0.36 ± 0.03 | 0.27 ± 0.03 | 0.26 ± 0.02 |
| deep root weight fraction | 0.52 ± 0.07 | 0.55 ± 0.04 | 0.70 ± 0.04 | 0.65 ± 0.05 | 0.60 ± 0.04 | 0.57 ± 0.07 | 0.55 ± 0.07 | 0.58 ± 0.04 | 0.56 ± 0.05 | 0.53 ± 0.03 | 0.58 ± 0.08 | 0.52 ± 0.11 |
| specific root length (m $g^{-1}$) | 59.69 ± 41.56 | | 51.60 ± 20.26 | | 44.85 ± 17.27 | | 22.38 ± 12.35 | | 13.28 ± 4.07 | | 41.29 ± 15.80 | |

Table S1. Mean values plus standard deviations for each species of the measured traits during the experiment. Abbreviations: RLAR = Relative Leaf Accumulation Rate.

Locations sites

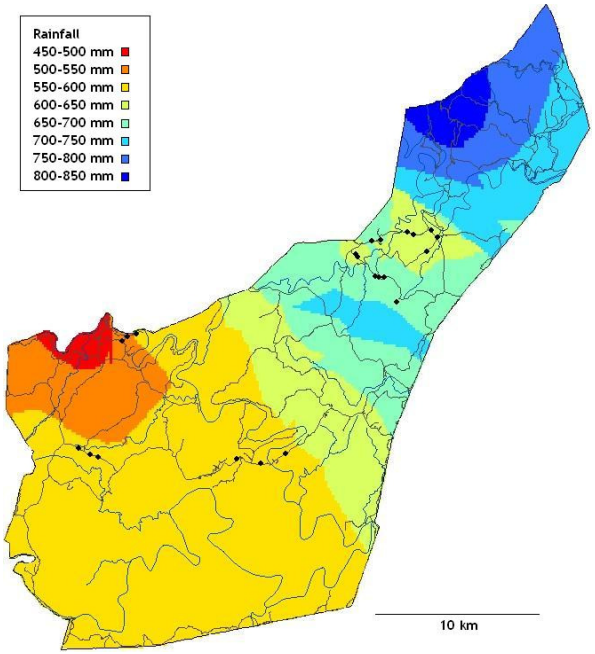


Figure S1: Locations of the sites that were visited for the field work of this study. Plots were distributed over the rainfall gradient of the park, except in the wettest sites, were grazing lawns hardly occurred.

Results survival analysis

In order to investigate whether lawn and bunch grasses differed in wilting point as a function of time (in weeks) or proportion water evaporated (in %), we performed two survival analysis models. In the first model, survival (i.e. not wilting) was a function of time (in weeks) and growth form (lawn grasses vs. bunch grasses) while in the second model, survival was a function of proportion of water evaporated (in %) and growth form (lawn grasses vs. bunch grasses). Only grasses from the drought treatment were included in the analyses, as none of the grasses from the control treatment wilted. Analyses were done using the survival package (Therneau 2013) in R (R Development Core Team 2011).

It appeared that lawn and bunch grasses did not differ in their resistance to wilting: both in response to time and proportion of water evaporated, they did not significantly differ in wilting point (survival analysis: week: $\chi^2 = 0.9$, P = 0.904; water evaporated: $\chi^2 = 1.2$, P = 0.272).

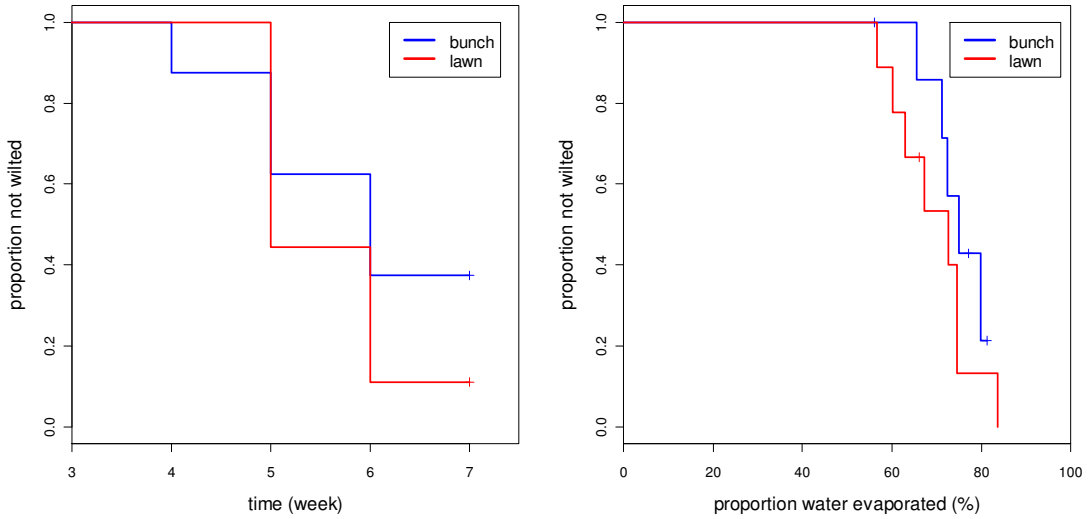


Figure S1. Wilting point of lawn (red) and bunch grasses as a function of time (left) and water evaporation (right). The small vertical lines depict pots were plants did not wilt. Differences in wilting between growth forms were not significant.

Results of ratio dead leaves:total leaves

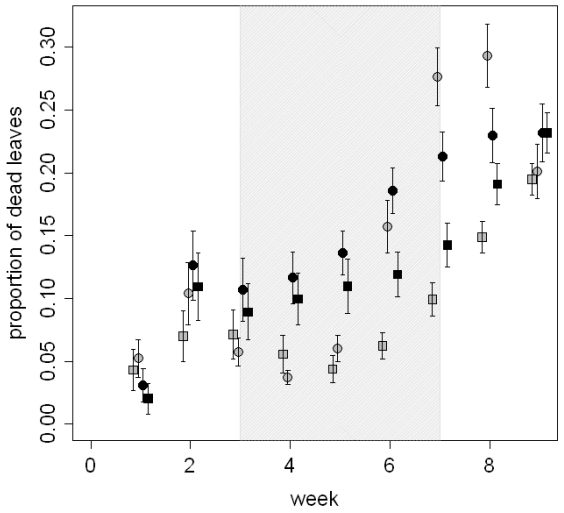


Figure S2. Graph showing the proportion of dead leaves through time (in weeks) for both lawn (grey) and bunch (black) grasses and for both control (squares) and drought (circles) treatments. The grey area in the graphs shows the drought period (week 3-7).

Roots of lawn and bunch grasses

Here two scans are shown that were used for calculating SRL: a root scan of *Digitaria longiflora* (lawn grass, left) and of *Setaria sphacelata* (bunch grass, right). *Digitaria longiflora* has more thin root hairs than *Setaria sphacelata*, but less thick roots at the base.

REFERENCES

Therneau T (2013) A package for survival analysis in R. R package version 2.37-4